International
IOR Rectifier

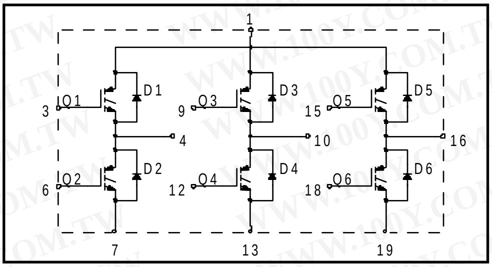
PRELIMINARY

PD- 5.042

CPV364M4K

IGBT SIP MODULE

Short Circuit Rated UltraFast IGBT



Features

- Short Circuit Rated UltraFast: Optimized for high operating frequencies >5.0 kHz , and Short Circuit Rated to 10µs @ 125°C, V_{GE} = 15V
- Fully isolated printed circuit board mount package
- Switching-loss rating includes all "tail" losses
- HEXFRED™ soft ultrafast diodes
- Optimized for high operating frequency (over 5kHz) See Fig. 1 for Current vs. Frequency curve

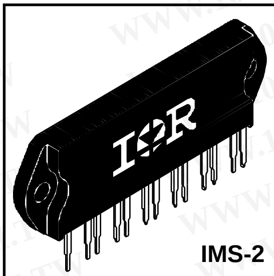
Product Summary

Output Current in a Typical 20 kHz Motor Drive

11 A_{RMS} per phase (3.1 kW total) with T_C = 90°C, T_J = 125°C, Supply Voltage 360Vdc, Power Factor 0.8, Modulation Depth 115% (See Figure 1)

Description

The IGBT technology is the key to International Rectifier's advanced line of IMS (Insulated Metal Substrate) Power Modules. These modules are more efficient than comparable bipolar transistor modules, while at the same time having the simpler gate-drive requirements of the familiar power MOSFET. This superior technology has now been coupled to a state of the art materials system that maximizes power throughput with low thermal resistance. This package is highly suited to motor drive applications and where space is at a premium.



IMS-2

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
I_C @ T_C = 25°C	Continuous Collector Current	24	A
I_C @ T_C = 100°C	Continuous Collector Current	13	
I_{CM}	Pulsed Collector Current ①	48	
I_{LM}	Clamped Inductive Load Current ②	48	
t_{sc}	Short Circuit Withstand Time	9.3	µs
V_{GE}	Gate-to-Emitter Voltage	±20	V
V_{ISOL}	Isolation Voltage, any terminal to case, 1 min	2500	V_{RMS}
P_D @ T_C = 25°C	Maximum Power Dissipation, each IGBT	63	W
P_D @ T_C = 100°C	Maximum Power Dissipation, each IGBT	25	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to +150	°C
	Soldering Temperature, for 10 sec.	300 (0.063 in. (1.6mm) from case)	
	Mounting torque, 6-32 or M3 screw.	5-7 lbf•in (0.55-0.8 N•m)	

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$ (IGBT)	Junction-to-Case, each IGBT, one IGBT in conduction	——	2.0	°C/W
$R_{\theta JC}$ (DIODE)	Junction-to-Case, each diode, one diode in conduction	——	3.0	
$R_{\theta CS}$ (MODULE)	Case-to-Sink, flat, greased surface	0.10	——	
Wt	Weight of module	20 (0.7)	——	g (oz)

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions	
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage③	600	——	——	V	V_{GE} = 0V, I_C = 250µA	
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	——	0.63	——	V/°C	V_{GE} = 0V, I_C = 1.0mA	
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	——	1.80	2.3	V	I_C = 13A	V_{GE} = 15V
		——	1.80	——		I_C = 24A	See Fig. 2, 5
		——	1.56	——		I_C = 13A, T_J = 150°C	
$V_{GE(th)}$	Gate Threshold Voltage	3.0	——	6.0		V_{CE} = V_{GE}, I_C = 250µA	
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	——	-13	——	mV/°C	V_{CE} = V_{GE}, I_C = 250µA	
g_{fe}	Forward Transconductance ④	11	18	——	S	V_{CE} = 100V, I_C = 10A	
I_{CES}	Zero Gate Voltage Collector Current	——	——	250	µA	V_{GE} = 0V, V_{CE} = 600V	
		——	——	3500		V_{GE} = 0V, V_{CE} = 600V, T_J = 150°C	
V_{FM}	Diode Forward Voltage Drop	——	1.3	1.7	V	I_C = 15A	See Fig. 13
		——	1.2	1.6		I_C = 15A, T_J = 150°C	
I_{GES}	Gate-to-Emitter Leakage Current	——	——	±100	nA	V_{GE} = ±20V	

Switching Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions		
Q_g	Total Gate Charge (turn-on)	—	110	170	nC	I_C = 13A		
Q_{ge}	Gate - Emitter Charge (turn-on)	—	14	21		V_{CC} = 400V	See Fig.8	
Q_{gc}	Gate - Collector Charge (turn-on)	—	49	74		V_{GE} = 15V		
$t_{d(on)}$	Turn-On Delay Time	—	50	—	ns			
t_r	Rise Time	—	30	—		T_J = 25°C		
$t_{d(off)}$	Turn-Off Delay Time	—	110	170		I_C = 13A, V_{CC} = 480V		
t_f	Fall Time	—	91	140		V_{GE} = 15V, R_G = 10Ω		
E_{on}	Turn-On Switching Loss	—	0.56	—	mJ	Energy losses include "tail"		
E_{off}	Turn-Off Switching Loss	—	0.28	—		and diode reverse recovery		
E_{ts}	Total Switching Loss	—	0.84	1.1		See Fig. 9,10, 18		
t_{sc}	Short Circuit Withstand Time	10	—	—	µs	V_{CC} = 360V, T_J = 125°C		
						V_{GE} = 15V, R_G = 10Ω , V_{CPK} < 500V		
$t_{d(on)}$	Turn-On Delay Time	—	47	—	ns	T_J = 150°C,	See Fig. 11,18	
t_r	Rise Time	—	30	—		I_C = 13A, V_{CC} = 480V		
$t_{d(off)}$	Turn-Off Delay Time	—	250	—		V_{GE} = 15V, R_G = 10Ω		
t_f	Fall Time	—	150	—		Energy losses include "tail"		
E_{ts}	Total Switching Loss	—	1.28	—	mJ	and diode reverse recovery		
L_E	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package		
C_{ies}	Input Capacitance	—	1600	—	pF	V_{GE} = 0V		
C_{oes}	Output Capacitance	—	130	—		V_{CC} = 30V	See Fig. 7	
C_{res}	Reverse Transfer Capacitance	—	55	—		f = 1.0MHz		
t_{rr}	Diode Reverse Recovery Time	—	42	60	ns	T_J = 25°C	See Fig.	
		—	74	120		T_J = 125°C	14	I_F = 15A
I_{rr}	Diode Peak Reverse Recovery Current	—	4.0	6.0	A	T_J = 25°C	See Fig.	
		—	6.5	10		T_J = 125°C	15	V_R = 200V
Q_{rr}	Diode Reverse Recovery Charge	—	80	180	nC	T_J = 25°C	See Fig.	
		—	220	600		T_J = 125°C	16	di/dt = 200Aµs
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery During t_b	—	188	—	A/µs	T_J = 25°C	See Fig.	
		—	160	—		T_J = 125°C	17	

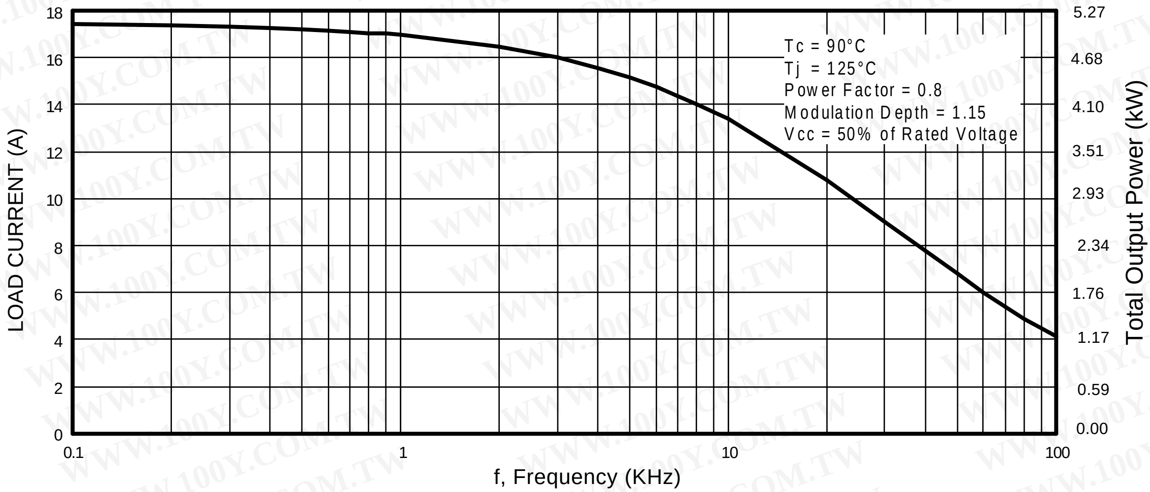


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

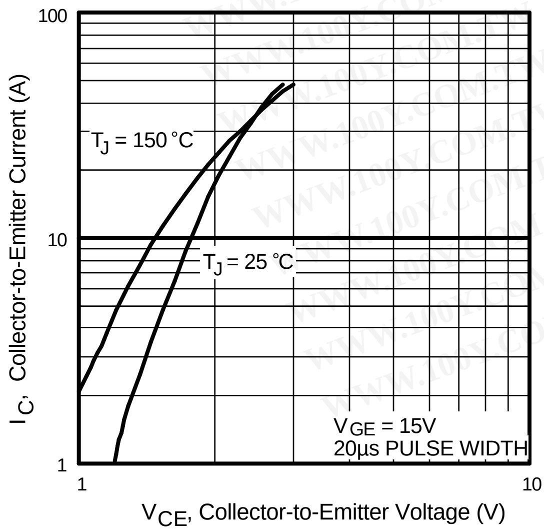


Fig. 2 - Typical Output Characteristics

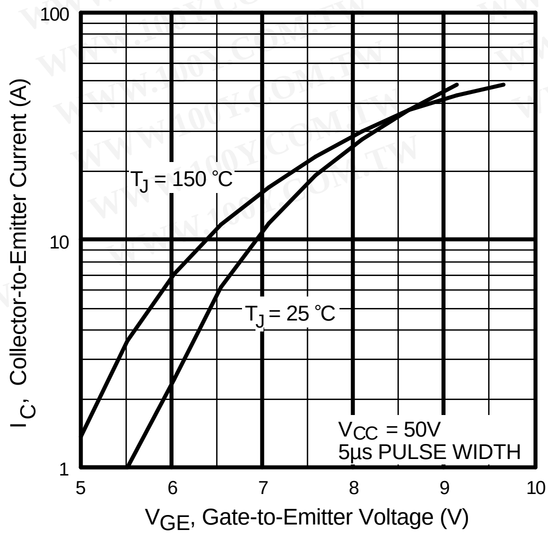


Fig. 3 - Typical Transfer Characteristics

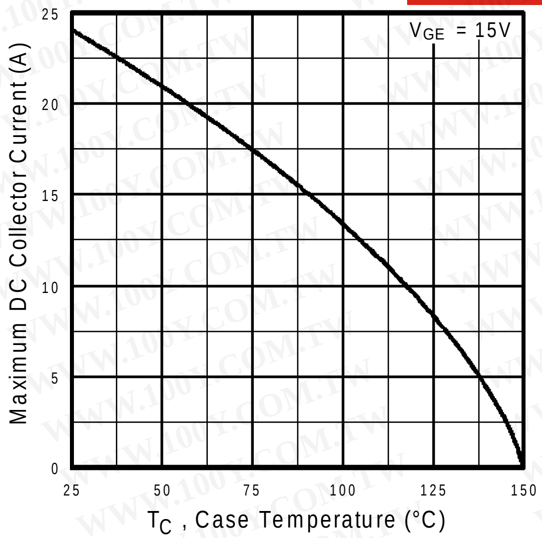


Fig. 4 - Maximum Collector Current vs. Case Temperature

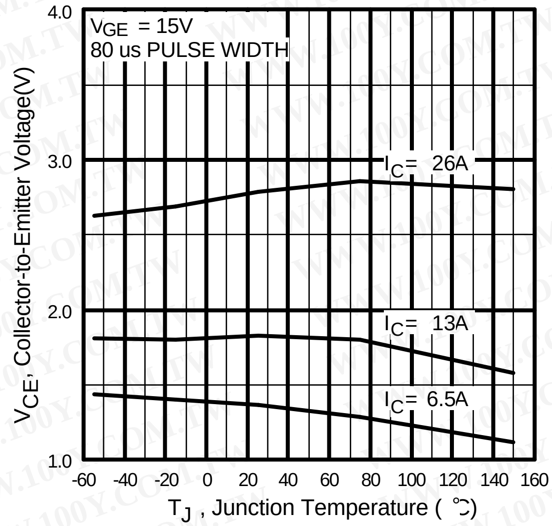


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

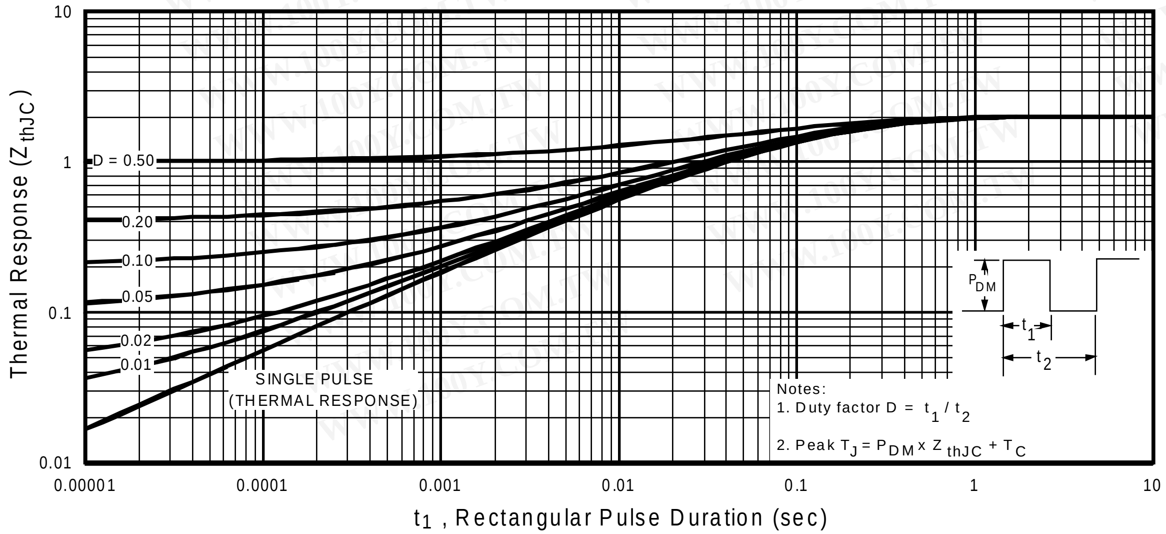


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

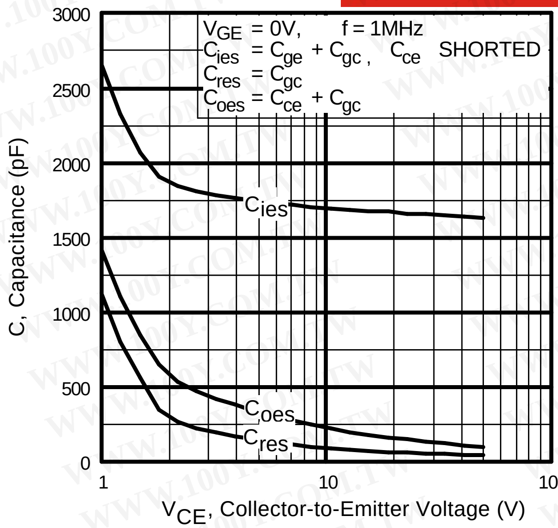


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

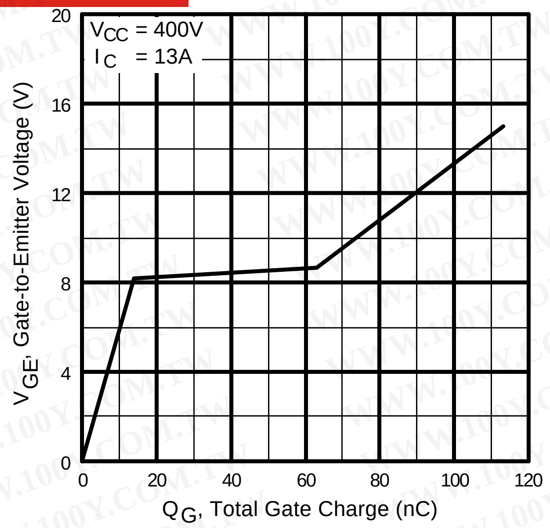


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

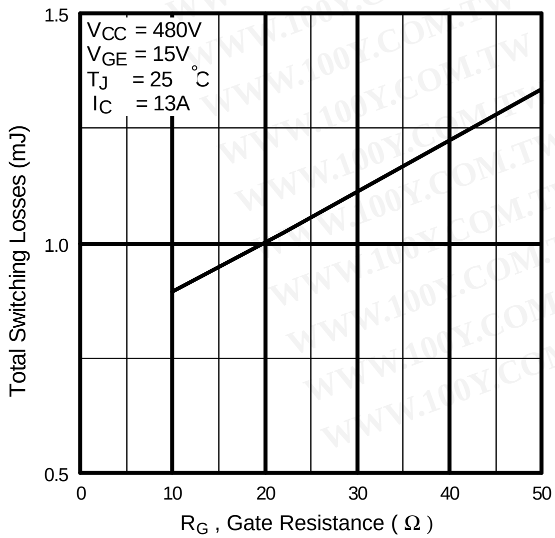


Fig. 9 - Typical Switching Losses vs. Gate Resistance

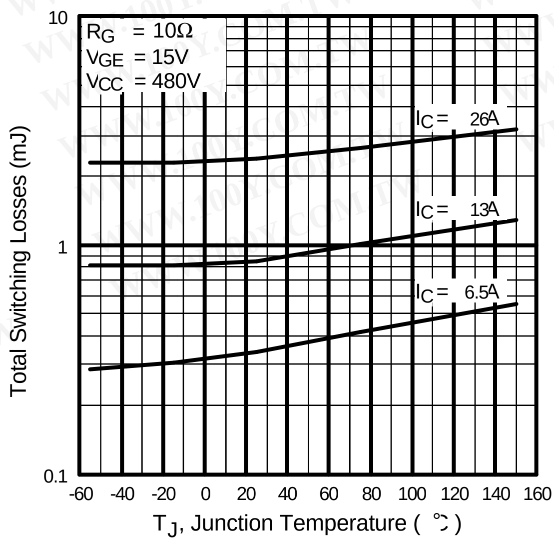


Fig. 10 - Typical Switching Losses vs. Junction Temperature

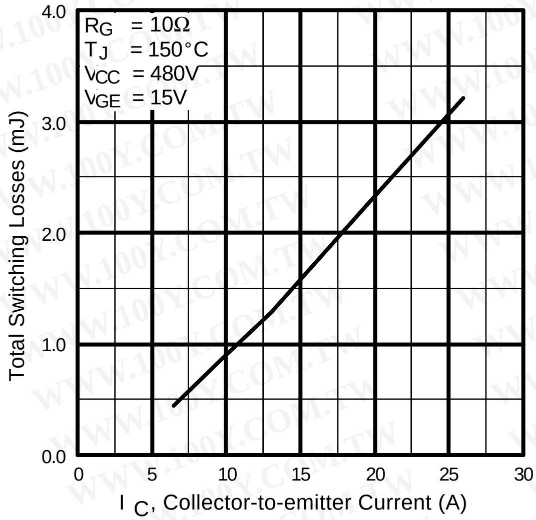


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

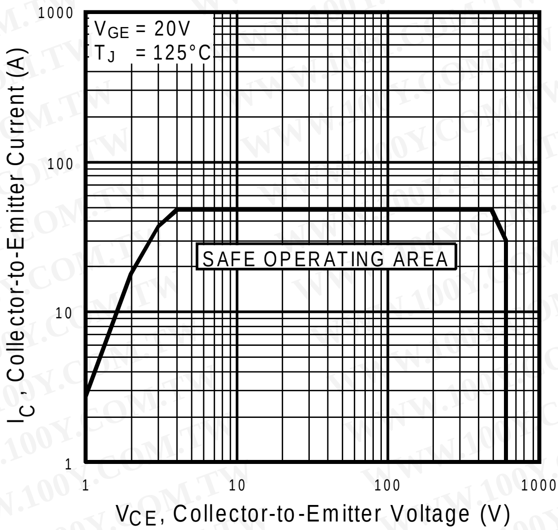


Fig. 12 - Turn-Off SOA

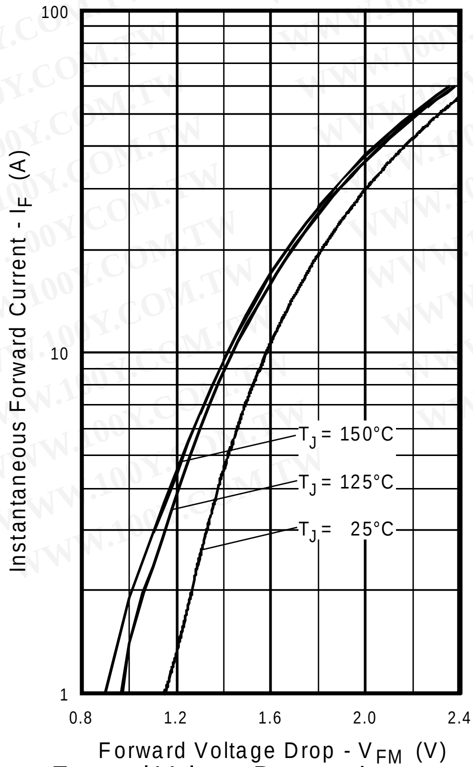


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

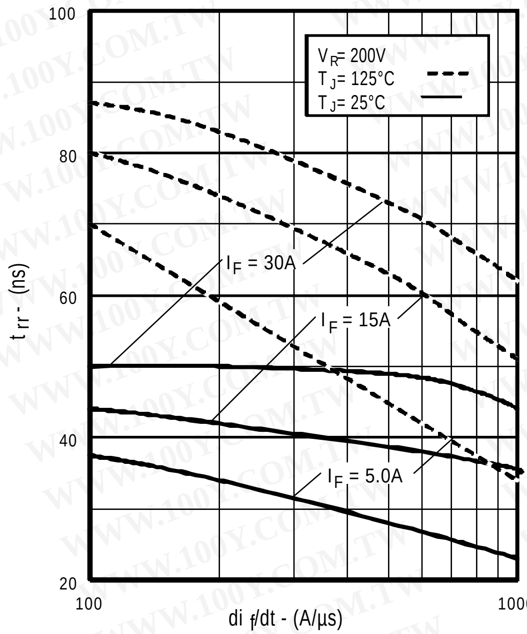


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

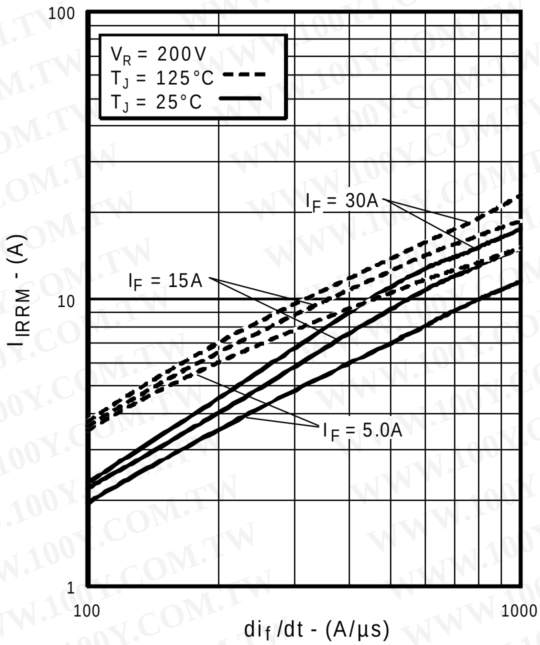


Fig. 15 - Typical Recovery Current vs. di_f/dt

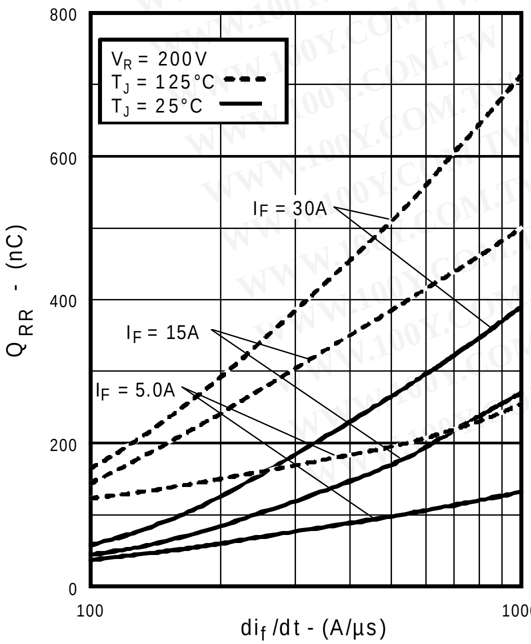


Fig. 16 - Typical Stored Charge vs. di_f/dt

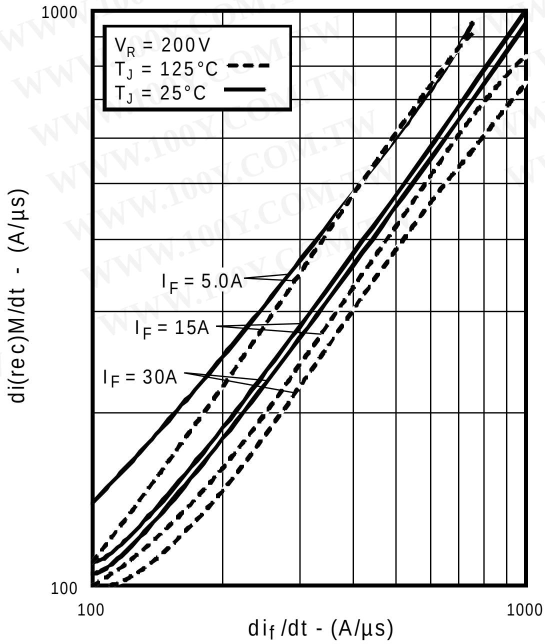


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

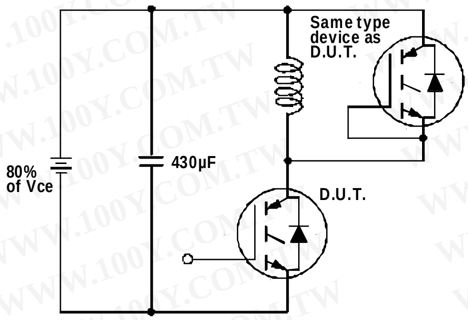


Fig. 18a - Test Circuit for Measurement of I_{LM}, E_{on}, $E_{off(diode)}$, t_{rr}, Q_{rr}, I_{rr}, $t_{d(on)}$, t_r, $t_{d(off)}$, t_f

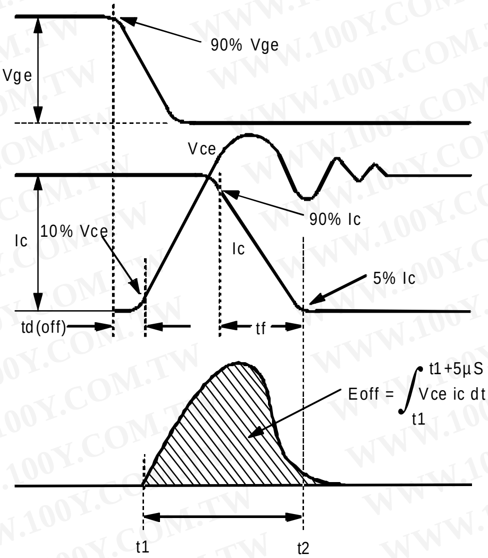


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off}, $t_{d(off)}$, t_f

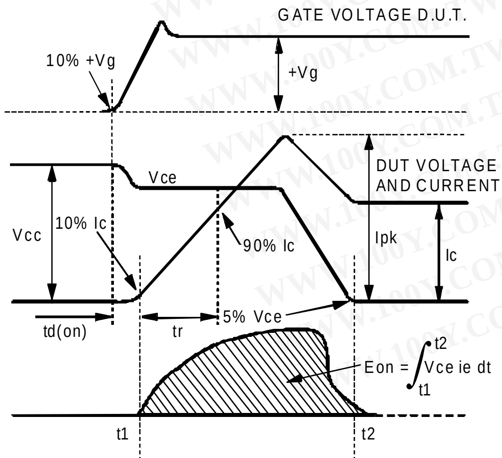


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on}, $t_{d(on)}$, t_r

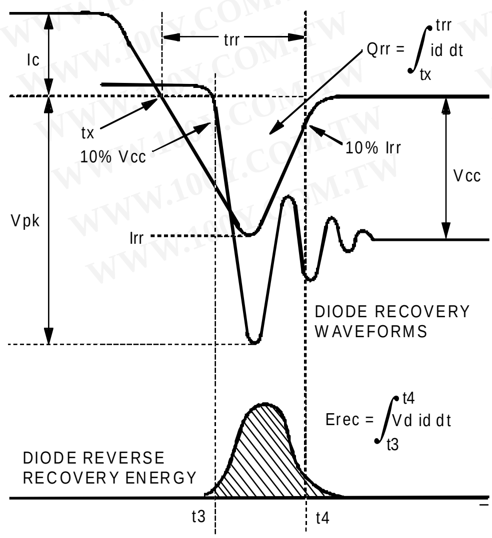


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec}, t_{rr}, Q_{rr}, I_{rr}

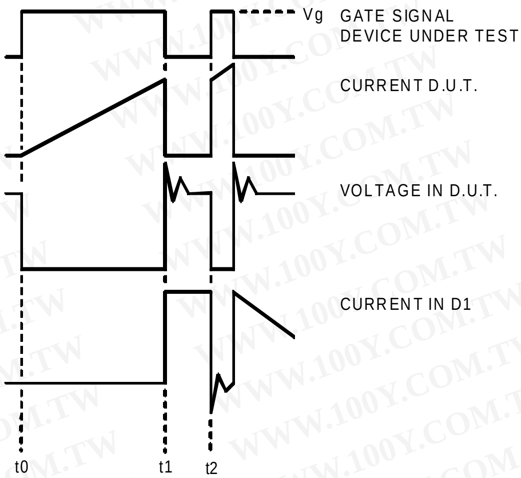


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

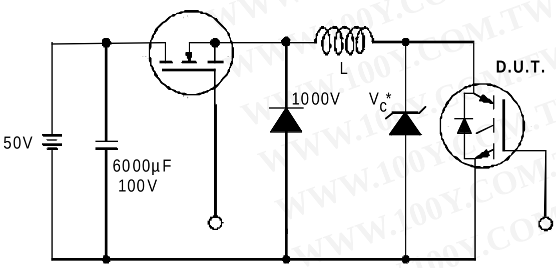


Figure 19. Clamped Inductive Load Test Circuit

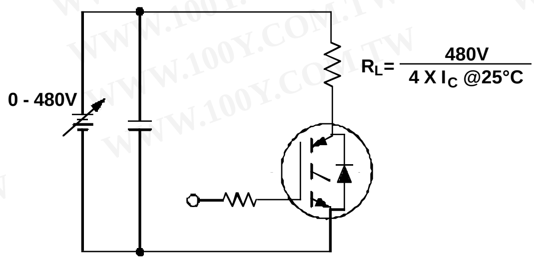
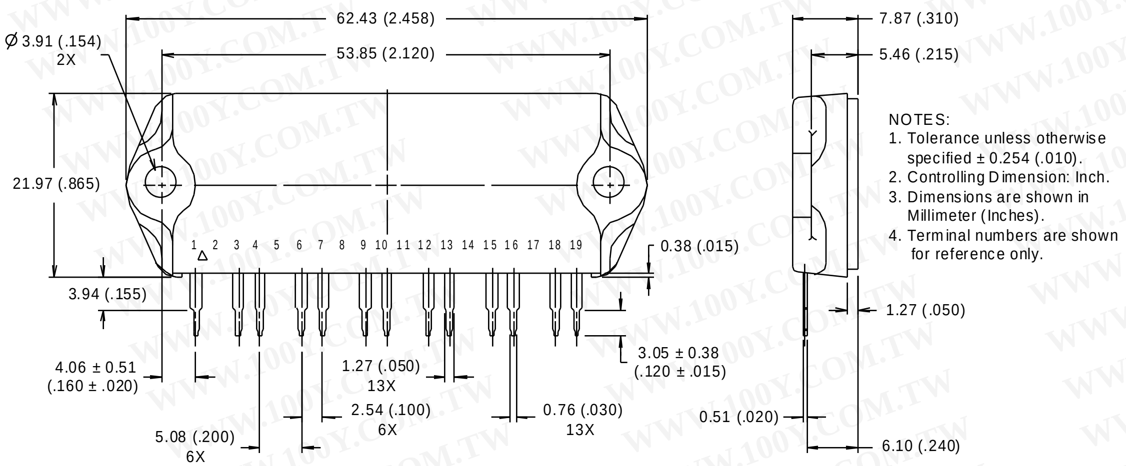


Figure 20. Pulsed Collector Current Test Circuit

Notes:

① Repetitive rating: V_{GE}=20V; pulse width limited by maximum junction temperature (figure 20)
② V_{CC}=80%(V_{CES}), V_{GE}=20V, L=10µH, R_G = 10Ω (Figure 19)
③ Pulse width ≤ 80µs; duty factor ≤ 0.1%.
④ Pulse width 5.0µs, single shot.

Case Outline — IMS-2



IMS-2 Package Outline (13 Pins)
Dimensions in Millimeters and (Inches)